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JONES (E. R.) & MACKIE (D. B.). **The Locust Pest.**—*Philippine Agric. Rev.*, vi, no. 1, Jan. 1913, pp. 5-22, 3 pl., 1 map.

The migratory locust is and has been for many years the most destructive insect pest of the Philippines.

In the term locust are included three, if not five, distinct varieties or species belonging to the genus *Acridium*. Some seem confined to Visaya, whilst others occur only in Luzon; the habits of all however are identical.

The losses from locusts in Visaya, the northern island of the group, during the latter half of 1912 amounted to 10,000,000 pesos (£2,083,000). Most of this damage resulted indirectly from one or two swarms originating in Bohol and extending over Cebu and Negros. It is believed that the swarms which recently infested Panay originated in the adjacent island of Guimaras.

In Mindanao there are vast areas of practically uncultivated land which form ideal breeding grounds, and it will not be possible for some time to come to eradicate the locusts from these areas, which the insects do not leave until they have attained sufficient vigour and numbers to necessitate a change of feeding grounds.

The authors then describe at length the well-known life-history of the locust. In the Philippines the average period of incubation of the migratory locust varies from 18 to 20 days. The young nymphs are known locally as "loctones" and these attack almost every kind of green herbage, though they frequently pass over potatoes, tobacco and beans, and hard substances such as sugar-cane; the stumps of shrubs and maize stalks usually escape. The young insects begin to move in a definite direction after the first day or two of their existence, covering only a few metres per diem, but by the time they are ready to move for the last time they will travel 3 or 4 kilometres between sunrise and sunset. The average time required for the nymph to reach maturity and acquire its wings is about 54 days, during which period it moults five times.

When all the loctones in a swarm have acquired their wings they usually remain for a few days longer in the immediate vicinity of their previous operations, sometimes apparently refusing to leave the old feeding grounds at all, provided there is a supply of food, but then after a few short local flights the entire swarm mounts into the air and travels, usually with the wind, at the rate of about 30 kilometres per day to a new breeding ground. Little is known of the conditions which influence the direction and extent of the flight of these swarms. Sometimes a swarm will return to the old ground several times before finally departing.

The mature insects give off a distinct odour, especially during and before the mating period, which may last for several days, and if the wind be favourable a swarm may be detected when it has alighted at night at a distance of 5 or even 8 kilometres.

The work of destroying the locusts is facilitated by the fact that the female lays the whole of her eggs in one cluster. As many as 4,000 to 5,000 egg-clusters have been found on one

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square kilometre of ground; but this does not mean that that number of females was to be found on that area at one time. These eggs would give rise to from 20,000 to 30,000 hoppers.

Destruction of Eggs.—Despite the most active operations the complete destruction of a winged swarm is practically impossible. The destruction of eggs in cultivated ground is a matter of great importance, and whenever practicable should be carried out as thoroughly as possible. The use of a plough with a mould-board is generally sufficient to bury the egg-masses to such a depth that when the loctones hatch out they are smothered in the earth, but with the ordinary Filipino plough it is necessary either to roll the land or ram it by hand. Where the plough cannot be used, digging out the eggs by hand has been found to give excellent results. Eleven persons in one place averaging about 125 litres of egg-clusters per diem.

Destruction of Loctones.—The principal defect of the simple pit and driving method is that the iron sheets or other materials required for constructing fences leading to the pit are not always readily available, and the carriage of large quantities of galvanised iron into the interior over bad roads to places where labour is scarce is impracticable. To remedy this, earthen dykes faced with banana sheaths (spathes) constitute a very effective method. The leaf blades of the banana should not be too small, otherwise the insects will simply devour the green portion of the leaf. These pit fences are erected about 20 metres in front of the advancing swarm; as many men and boys as the size of the swarm may require are then set to work to drive it with sticks and branches towards the pit. It is very important not to drive too fast, otherwise the swarm becomes a mere struggling mass and difficult to direct. Under ordinary circumstances after the construction of the fence and pit a swarm covering, say, 100 square metres or thereabouts, should be inside the pit within an hour from the beginning of the drive. Once in the pit the insects can be destroyed in the usual way.

On level ground the net method may be used to destroy the young hoppers with considerable success. The side of the net in contact with the earth should be kept straight by means of a straight stick, the upper part having a bow-shaped piece of wood attached to the rim to hold it wide open. In certain cases extra large nets drawn by horses may be used. The net should be constructed of coarse cloth or gunny sack. The winged insects, when roosting, may be captured in large numbers by the use of hand-nets which are swept over the bushes. It is perhaps unfortunate that the people in Sebu rarely use locusts for food, but in several provinces of Luzon, and to some extent in Leyte and Bohol, the Filipinos use nets to capture the locusts for food. Locusts are peculiarly cleanly insects, and the suggestion that they may carry germs of cholera and typhoid fever is absolutely negligible, especially if they are roasted or otherwise cooked before being eaten.

Rolling may be successfully used to crush the loctones on level ground. A straight smooth log 40 to 60 centimetres in diameter (16″ to 24″), but the larger the better, drawn by cattle attached to either end, makes a good roller.

When the young hoppers are hidden in grass and brush on rough ground it is sometimes possible to cut the herbage over the infested area and set fire to it as soon as it is dry enough to burn. The destruction of the locusts is practically complete if there be a fair quantity of combustible material. The objection to the method is that a large amount of labour is required to cut the grass and that it can seldom be used in the rainy season. Another method is to use a burning jet of petroleum. An ordinary spray pump with the nozzle fastened to the end of a pole 6′ to 8′ long can be converted into a powerful burning torch, which is effective even in rainy weather. Any surplus oil which may escape continues burning on the insects or herbage. The objection to its use is the danger of accident in the hands of inexperienced operators, and the cost.

Insecticides.—These may be used against locusts in any stage, either as contact sprays or as poisonous solutions. Kerosene is one of the best sprays, but for general field work it is expensive, and the modification known as kerosene emulsion is much cheaper and very useful against young loctones.

The use of arsenical poisons is dangerous because:—(1) the Philippine planters are unfamiliar with them; (2) there is great danger of poisoning domestic animals; (3) many useful birds might be destroyed by eating the poisoned locusts.

In special cases, however, lead arsenate or a sweetened mixture of white arsenic may be used by experienced persons with good effect.

Inoculation.—A fungus (*Empusa grylli*) has been used with some success, it is said, in America against locusts, but it appears that it is only under very favourable conditions that the disease spreads with sufficient rapidity to destroy any large numbers, and the method cannot be recommended in consequence of its expense.

Natural control.—Heavy rain just after or during the moulting period, or at the time of hatching, is very effective against the young hoppers, and vast numbers are destroyed in this way. Sometimes heavy rains have been known to cause local floods which have carried sufficient silt on to land loaded with locust eggs, and has covered them to such a depth with an almost air-tight paste of fine mud that almost all the insects were suffocated as soon as hatched. It would appear also that excessive moisture in the soil during the incubation period considerably reduces the vitality of the young insect.

The authors found that four days' submersion in water destroyed 25 per cent. and six days' submersion the whole of the eggs in a cluster. They found also that if egg-clusters were thoroughly drenched with water daily the young loctones produced therefrom were very feeble, and that none of them lived more than eight days after hatching.

Among the predaceous enemies may be classed birds (including poultry), domestic animals, such as dogs and pigs, and insects. The cannibal habits of the locust are also important. They will eat injured or sickly individuals and this increases the efficiency of arsenical sprays, for the poison has been found to extend to the fourth successive individual. Of natural enemies, wild birds

are much the most important, and of these the most effective locust destroyers known at present are:—Luzon Shrike (*Otomela lucionensis*, L.), Carabao Bird (*Bubulcus coromandus*, Bedd.), Kingfishers, Variegated Curlew (*Numenius variegatus*, Scop.), Golden Plover (*Charadrius fulvus*), Button Quail, Jungle Fowl (*Gallus gallus*, L.), Yellow-billed Roller (*Eurystomus orientalis*, L.), and Bee-eaters (*Merops americanus*, Müll., and *M. philippinus*, L.).

It is probable that insect parasites exist, but the authors have not as yet been able to study this question thoroughly.

D'Arenberg (Prince P.). **A possible method of preventing the attack of *Pieris brassicae* on Cabbages.**—*Bull. Soc. Nat. d'Acclimat.*, 1st Jan. 1913, p. 18.

The author has made an observation that if hemp (*Cannabis sp.*) or broom (*Genista sp.*) be planted between the rows of cabbages, *Pieris brassicae* appears to avoid them, and he found that on placing two cabbages in a gauze cage with a tuft of *Cannabis* near to one of them and then introducing a large number of the insects, they avoided the cabbage near which the hemp was placed and collected on the opposite side of the cage.

It is a matter of belief amongst gardeners in certain parts of France that the odour of some plants is distasteful to certain insects, but precise observations are wanting. Mere strength of odour is certainly not distasteful, because the caterpillars of *Papilio machaon* eat the leaves of fennel with great avidity, and many Coleoptera and Hymenoptera are very fond of the flowers of the onion and of parsley.

Clément (—). **Branches of Gooseberry attacked by the caterpillar of *Sesia tipuliformis*.**—*Bull. Soc. Nat. d'Acclimat.*, 1st Jan. 1913, p. 20.

The author exhibited before the Society a number of branches of the gooseberry attacked by the caterpillar of *Sesia tipuliformis*, which was lodged in some cases in the pith. This species does not push its excrement out of its burrow as is the case with *Cossus* and *Zeuzera*. The imago generally appears at the end of May. The female lays about sixty eggs in cracks in the bark or on branches of less than one year old, and the larva penetrates into the pith, burrowing a tunnel in which it passes the winter and which it enlarges at the end into a kind of chamber near the surface, where it forms a cocoon of silk and small fragments of woody fibre. Branches so attacked dry up and die in the following year. The pupal stage lasts about 18 days, and the appearance of the insect causes it to be mistaken by unskilled observers for a fly. It is found on the branches of the red and black gooseberry, and also upon the black elder, on sumac and hazel. No satisfactory means of combating this pest appears to have been discovered. Cutting the dead branches and burning them does not appear to be sufficient, because the part cut does not always contain the larva and it is possible to damage the bush by cutting too far back,

Noel (Paul). **Les Ennemis des Épinards.** [The insect enemies of spinach.]—*Bull. Laboratoire Régional d'Entom. Agric., Rouen*, 1913, pt. 1, p. 13.

The author states that the larvae of the following Lepidoptera eat the leaves of spinach:—*Arctia villica*, Hb., from September to May; *Amphipyra tragopogonis*, L., and *Heliodines roesella*, L., in June.

Walden (B.). **A new Sawfly Pest of the Blackberry, *Pamphilius dentatus*, MacG.**—*Rept. Connecticut Agric. Expt. Sta., New Haven, Connecticut*, 1912, pp. 236-240, 3 pl.

The sawflies were collected by the author originally in 1910 and described by A. D. MacGillivray as a new species. Large numbers have been discovered in the original area in the succeeding years, the adults appearing from the latter half of May up to the middle of June. The eggs are laid in rows on the under side of the leaf, and in 1912 practically all were hatched by June 25th. The larva spins a few threads by which it draws a portion of the leaf over itself, forming an incomplete tube within which it feeds. When several eggs are laid on one leaf, the larvae collect together in one web. The habits of the insect are quite similar to those of the peach sawfly, *Pamphilius persicum*. The eggs, larvae, and adult insect are described, and the author adds that it is impossible to say at the present time whether the insect is likely to become a serious pest of blackberries, but that in the last two seasons it has spread over a considerable area. It apparently does not feed on any other species of plant. Black and red raspberries adjoining one of the infected blackberry fields were not attacked by it.

Kirk (H. B.). **The Walnut Bud-Moth.**—*Rept. Connecticut Agric. Expt. Sta., New Haven, Connecticut*, 1912, pp. 253-258.

The author noticed whilst studying the walnut weevil, nests of Lepidopterous larvae on the tips of the branches of Persian walnut (*Juglans regia*) and discovered that the larvae were burrowing into the buds and new shoots and causing nearly as much damage as the walnut weevil itself. These larvae were observed more than three years ago by Dr. Morris, but he was under the impression that they were the larvae of the walnut weevil, *Conotrachelus juglandis*. There are three generations in each season. The eggs are laid singly on the base of the bud and sometimes on the leaves, and hatch in 6 to 10 days. The larvae feed on the buds, leaves, and stems. The walnut weevil extrudes its "frass" by pushing it out from the egg punctures at the base of the petioles or along the stem, but never at the terminal end of the new shoot. In the work of the larvae which the author describes, the tips of the shoots die and the "frass" is retained, being afterwards used with the leaves to form a nest which contains most of the pupae and is the most conspicuous evidence of

the presence of this insect. The adults emerge two or three weeks after pupation. It was at first considered that the insect was *Acrobasis caryae*, Grote, to which the adults bear the closest resemblance; but it may prove to be an undescribed species.

MARCHAL (Paul). **Rapport sur les Travaux Accomplis par la Mission de l'Etude de la Cochylis et de l'Eudémis pendant l'année 1911.** [Report on the results obtained by the Commission for the study of *Cochylis* and *Eudemis* during the year 1911.] pp. 1-326, 2 pl., 60 figs.

Biology, influence of environment and natural enemies.—The author summarises the results of the work as follows:—The perfect insects of *Clysia ambiguella* (*Cochylis*) and *Polychrosis botrana* (*Eudemis*) do not live sufficiently long to effect the laying of their eggs unless they are in a position to obtain liquid food. Pure water appears to be generally sufficient. They are attracted by sugary material in a state of fermentation and drink sweet liquids greedily; but this substantial food only slightly prolongs their existence, which may be put at three weeks for the spring brood and about 12 days for the summer one. The functional activity of the insect requires moisture, and its love of moisture explains the abundant laying of eggs even during the day-time when the atmosphere is moist, *e.g.*, "when the sea-wind is blowing at Montpelier." For the same reason its localisation and its abundance in the moist parts of the vineyards, its attraction by water and the damage caused by it in vineyards which are regularly watered is explained. Inversely, dehydration of the body of the insect which is brought about by heat, drought and the absence of dew, accounts for the diminution or the practical suppression of the second brood which was observed in France in 1911 in numerous vineyards, and notably in Champagne. The number of eggs contained in the two ovaries averages 160 for *Clysia* and 120 for *Polychrosis*. The number of eggs actually laid in the course of the normal existence of the insects seems to be always considerably less than the numbers given, and rarely exceeds 60 or 80. The egg is laid on the flower-bud and no special point is chosen, though the first brood generally deposits its eggs on the bracts, the pedicels or on the bunches of grapes, or sometimes on the new wood at some distance from the bunches. In captivity the insects lay their eggs frequently on any object whatever, even on the glass walls within which they are confined.

The period of development of the egg varies with the temperature; in the case of the first brood of *Clysia* it is 7 days, and for the summer brood only 4 days. In the case of *Polychrosis* the period varies from 4½ to 8 days. Emergence always takes place from the upper surface of the egg, and the young caterpillar is very active and travels a considerable distance according to the position of the egg and the temperature conditions at the time; the first attack does not generally commence until several hours or even a whole day after emergence. In certain cases, which are however somewhat rare and which arise only in summer during very great heat, the caterpillar of *Clysia* emerges from the underside

of the egg and bores at once directly into the food material beneath.

The varied appetites both of *Clysia* and *Polychrosis* have been everywhere confirmed. They live and feed on the flowers and fruits of various trees (black currant, gooseberries, cornel, jujube, viburnum, wild plum, etc.) and also on a number of small plants such as *Galium mollugo* and *Silene inflata*. In the south, *Polychrosis* appears to be particularly fond of *Daphne gnidium*, whilst the caterpillar of *Clysia* can adapt itself to living upon the woody parts of certain plants. This capability of living on many plants other than the vine explains the spread of the pests from one vineyard to another even when there is a considerable intervening space free from vines, and enables us to understand the possibility of the persistence of the second brood of *Clysia* in spite of the total destruction of the harvest by mildew and by *Clysia* itself, such as happened in many vineyards in 1910.

Experience has shown not only that the number of eggs laid upon the bunches exposed to the sun is smaller, but that large numbers of these eggs so exposed never reach maturity, and that a large proportion of the young caterpillars which emerge are killed by the sun's rays. The excessive heat and dryness were the factors which chiefly contributed to the destruction of the second brook of *Clysia* in 1911, though they had much less effect upon *Polychrosis*. In Champagne the insects of the second brood suffered most, but in the Bordeaux district the effect was chiefly upon the caterpillars at the moment of their transformation and on the pupae. Numerous observations have been made on the natural enemies of both these moths. A parasitic Hymenopteron, *Copthora semblidis*, capable also of parasitising the eggs of various other insects, has been discovered in the eggs of *Clysia* and of *Polychrosis*. Details of the operations of these parasites are given in the body of the work as also the action of certain vegetable parasites.

Treatment.—In consequence of the period at which the Committee for the study of *Clysia* was appointed, the question of winter operations against the pest, which are very important, was not thoroughly studied during the year 1911, and is still under consideration. Chemical treatment by means of sprays during the period of growth and chiefly in spring-time remains the principal means of attacking these pests. The mixtures which have proved the most effective are preparations of nicotine, and particularly "bouillie bordelaise" combined with nicotine. The action of these preparations is at the same time that of a deterrent to the moth, a destroyer of the eggs and an external and internal poison to the caterpillars. Their efficacy can be defined as follows:—(1) 0·13 per cent. of the pure alkaloid will destroy a very large number of eggs by killing the embryo just as it is about to emerge, and this action will hold good for six or seven days after the application of the spray; (2) the young caterpillars which occur on bunches previously treated with a solution of nicotine of the same strength, die in great numbers even five or six

days after spraying, this being probably due to the ingestion of the liquid and the inhalation of the vapour given off; (3) nicotine solution of the strength 0·13 and 0·15 per cent. produces a great mortality amongst caterpillars when applied directly, especially if they are in an early stage of their growth; this direct action is much more powerful in the case of *Polychrosis* than in that of *Clysia*, and this appears to be true also of all external insecticides.

In order to obtain the best results, nicotine sprays should be applied with the idea of prevention, that is to say, during the period of oviposition and in a manner based upon biological observations and experience. The question of the most favourable moment for the application of the spray is of the highest importance; the experience of the past year has shown that the period when the best results can be obtained does not always correspond with that of the greatest abundance of caterpillars, but that the state of growth of the vine is a very important element in the question. The addition of substances which will increase the wetting power of the sprays such as soap and treacle greatly assists their efficacy. [*Cf.* this Review, p. 46.]

Arsenical mixtures (arsenate of lead) properly applied appear to be equally efficacious with the nicotine solutions, and those cases which have occurred in the past year in many districts in which the result was unsatisfactory can be explained by the defective conditions of application or from the mixtures having been badly prepared. Some authorities have denied the value of arsenical preparations because the poisoning of the caterpillars frequently takes place with great slowness, and because they act rather in reducing the numbers of the next brood. Arsenical mixtures poison through the alimentary canal and consequently the favourable time for preventive application is more limited and more difficult to determine than in the case of nicotine, because if applied too early they are useless. Further, they must be applied each time that fresh broods of the moths are observed to be produced and consequently their application must be extended over a longer period. These various considerations render the effects of arsenic more fugitive than those of nicotine preparations.

Barium chloride is a substance with which further experiments should be made in this connection. Its action is somewhat analogous to that of arsenic, and it has the advantage of not presenting the same risks of poisoning human beings. In the Bordeaux district very favourable results have been obtained, but burning of the leaves has been reported from many districts, even when it has been used in a relatively weak solution. It is possible that this may have arisen from impurities in the material used, or from the conditions under which the application was made. A further study of this insecticide is very desirable.

In order to complete the preventive action of nicotine, other insecticides which operate in a similar manner, that is to say as external poisons, have been tried during the past year. Amongst these, fresh pyrethrum powder mixed with soft soap may be considered the best against the first brood, whenever

the value of the harvest is sufficiently high to permit of its employment. If the cultivation of the plant is fostered in Northern Africa it will be possible to obtain the material in large quantities at a more reasonable price than at present. If for the greater number of vineyards the spring treatment does not afford a basis for an effective war upon the vine moths, the summer treatment is on the other hand far more fugitive in its results, except in the case of those vineyards where the harvest is of special value. Sprays, even with solutions of nicotine, cannot be made with too great care if the best results are to be obtained; arsenical spraying at this time of year should be altogether rejected, not only because of the risks to health, but because it is ineffective. We are thus left with the use of powders applied at the moment when the moths are about to take wing as the only chemical treatment of general application against the summer broods, but the technical details of their use require to be much further studied before any exact statement of their value can be made.

The destruction of the moths either by lantern-traps or by baits, which have been in use in the past year, is an excellent supplement to that of the use of insecticides against the caterpillars in the spring. The use of lantern-traps as practised in Champagne (either electric or acetylene lamps) is of no avail against *Polychrosis*, but is efficacious against *Clysia*, provided certain rules are observed in the arrangement of the luminous network and the disposition of the lamps. The maximum result is obtained during a succession of warm nights, and it may be allowed that where the value of the vintage is considerable, the lantern-trap method is practical and not over-expensive. It must not be forgotten however that this method involves the destruction of a great number of Hymenopterous parasites and other insects which are of great service, and this detracts somewhat from the value of the method. The system of destruction by baits has not thus far given results of sufficient consistency to permit of its being classed definitely amongst the methods of practical utility against the vine moths, but possibly when more is known of the details which are requisite in the use of these traps the method will be found to be of real service.

A large portion of the southern vine area, in consequence of the method of cultivation adopted, the strength of the fruit-bearing branches, the rapidity of the growth of the bunches and the low value of the vintage, does not lend itself to the application of sprays, nor of those preventive operations which require great care in carrying out. Over this area attention must be chiefly paid to the extensive application of winter treatment and of methods of cultivation which may serve as preventives, and the protection or the utilisation of parasites. In a general sense great hopes may be based on the organisation of what may be called "the natural war" against these moths, either by favouring the multiplication of parasites or by creating artificial foci of epidemics, but without neglecting the investigation of new insecticides or the perfecting of methods actually in use.

Green (Ernest E.). **Note on experiments with Mr. Beddewela's Termite Mixture.**—*The Tropical Agriculturist*, xl, Jan. 1913, p. 5.

Mr. Beddewela having invited a test of his Termite mixture, an appointment was made with him for the 11th October. On that date several termite nests (inhabited by *Termes redemanni* and *T. obscuriceps*) were opened under Mr. Beddewela's supervision, and treated with his mixture. This preparation is in the form of sawdust impregnated (according to the inventor) with certain medicinal oils. After the nests had been opened to a depth of a foot or eighteen inches, the mixture was sprinkled freely over the exposed surface. Some of the nests were immediately filled in with loose earth, others were left open. Mr. Beddewela's instructions were that the treated nests should be left open for several days (up to a week) before being filled in. Unfortunately, through some misunderstanding, the nests, which should have remained open were filled in and turfed over during the following two days. The inventor claims that the treatment will result in the death of the insects or—if not—in the discontinuance of their work at that spot. Most of the nests that were subjected to the experiment showed signs of renewed activity within a week of the date of treatment, and fresh earth-work was still noticeable after an interval of three months; but the colonies appear to be greatly weakened and the work is much less than might have been expected under normal conditions. If exposure for the specified time is an essential part of the treatment, there is a possibility that the practical recrudescence may be due to the too early closing of the treated nests. It will be necessary to repeat the experiment under more exact conditions and with proper controls.

Chaine (J.). **Traitement des buis contre le *Monarthropalpus buxi*, Lab.** [Treatment of box trees against the attack of *M. buxi*, Lab.]—*C. R. Hebdom. Soc. de Biologie*, lxxiv, no. 3, 24th Jan. 1913, pp. 156-158.

The Cecidomyia of the Box (*M. buxi*, Lab.) is a small Dipteron, the larva of which attacks chiefly the common box tree, living in the interior of the parenchyma of the leaves into which it burrows.

In order to destroy the larva and protect the shrubs it is no use attempting to destroy the adult insect, as these, in consequence of their powers of flight, are very difficult to catch. It is also exceedingly difficult to kill the larvae and the nymphs, as they are so well protected in their burrows. The chief method available is to prevent the laying of eggs by the insect, and the author gives the following as the result of observations made by himself in gardens in Bordeaux.

This Cecidomyia will not lay its eggs upon dusty leaves. He has observed that the female approaches such leaves, circles round them in the attempt to find a suitable place for settling

upon and if one cannot be found she flies away. For this reason trees growing along the line of frequented roads are naturally protected against the insect. It would further appear that the nature of the substance spread upon the leaves in the form of dust has nothing to do with the refusal of the insect to lay its eggs. It is sufficient that the surface of the leaf shall be dirty.

The author experimented with sulphur and soot, but he is of opinion that any kind of fine dusty matter will answer the purpose. Not only is dust distasteful to the insect, but any kind of dirt; a sprinkling of the leaves with nicotine solution or even with soapy water was effective. The use of any kind of spray or powder is rendered a little difficult by the fact that to be effective it must be applied to the under surface of the leaves, and it is waste of labour to spray the trees in the ordinary manner. It is also useless to do this except just at the time when the insects are about to lay eggs, and he has found that flowers of sulphur applied in the following manner has given the best results:—

The under surface of the leaves is carefully wetted with a spray apparatus, proceeding from below upwards, and immediately this is applied a pair of bellows containing flowers of sulphur and fitted with a piece of wire gauze at the end of the nozzle, is brought into operation. He found that the particles of sulphur attached themselves to the wetted leaves and adhered for a very long time after the water had evaporated. It is very necessary that this operation should be conducted with care, and thoroughly, because the female fly will certainly lay its eggs upon any leaves which may have escaped treatment.

The period of oviposition of this Cecidomyia lasts from two to three weeks, and it is thus advisable to repeat the operation once or twice during this period, as rain, wind and the growth of the leaves might render it necessary. In spite of all that can be done, some eggs will be laid and some leaves damaged, and the writer recommends that the trees should be examined about the end of January or the beginning of February, and that the leaves with galls on them should be removed by hand. No precaution need be taken to destroy the infected leaves because the larvae of *M. buxi* die as soon as the leaf on which they are living has been separated from the branch.

Scale-Insects in the Seychelles.—*Ann. Rept. Dept. Agric. and Crown Lands, Seychelles*, 1912, p. 9.

Great relief was experienced this year on finding, after the advent of the wet season, that natural parasites were keeping scale-insects under control. The artificial methods of control, such as spraying, etc., were too expensive to be adopted on a large scale, and in the meantime the scale-insects have been gaining ground all over the country. The period of violent attacks by scales is over in the more infested places, and it is to be hoped, now that the controlling parasites are in the ascendant, that the natural means of combating scales will be adopted at

once in other places. From 1905 to 1911 the periods of drought favoured the development of scales, and the first wet season in the islands for the last seven years is sufficient to cause the natural parasites to appear.

The green scale (*Lecanium viride*) is attacked by a white fungus on coffee and Funtumia rubber; the black scale (*Lecanium nigrum*) on Hevea rubber by a reddish brown fungus (a species of *Hypocrella*, according to Petch); the star scale (*Vinsonia stellifera*) on gutta-percha by a greyish white fungus; the mealy bug (*Icerya seychellarum*) on lovi-lovi (*Flacourtia inermis*) by a red-headed fungus.

These fungus parasites have been found at 800 feet above the sea, although the white fungus on *Lecanium viride* and the reddish brown fungus on *Lecanium nigrum* are present here and there in the low country. No time should be lost in propagating them all over the Archipelago. This is being done already by one or two planters by tying leaves and twigs infected with fungi to other trees attacked by scale-insects which are not parasitised.

Injurious Insects of St. Lucia.—*Rept. Agric. Dept., St. Lucia*, 1912, p. 11.

A Tobacco Insect.—A trial plot of tobacco in the Soufrière districts was practically destroyed by a leaf bug of the family Capsidæ, some of which are serious pests. The plot was visited and remedial measures were recommended, but the cultivation was abandoned.

Scale-Insect Fungi.—A fungus found growing on leaves of Java plum (*Eugenia jambolana*) was reported by the Mycologist to be the same as one found on the leaves of the star apple (*Chrysophyllum cainito*) in Dominica, and identified at Kew as the conidial stage of *Hypochrella oxyspora*, Massee. The fungus is regarded as an important one, as it is probably parasitic on scale-insects, like several other species of the same genus.

The fungus *Ophionectria coccicola*, commonly known as the white-headed fungus of scale-insects, that plays such an important part in the control of these pests in Dominica, has been discovered to occur in St. Lucia. It was first recorded here as occurring on scale-insects on an orange tree in the heights of Vieux Fort. It has since been found at Soufrière and efforts are being made to spread it.

Insect Pests.—What appears to be the burrowing scale (*Howardia biclavis*), on the stems of young *Castilloa elastica* plants in the nursery, was found to be parasitised by the red-headed fungus (*Sphaerostilbe coccophila*). Other insects that have been collected and submitted to the Head Office for investigation are : lace bugs, found on the leaves of the egg-plant and probably identical with *Corythaica monacha*; a fly on lime trees; and a red-coloured mite parasitic on the common house-fly.

Parasitic Fungi on Scale-Insects in Dominica.—*Rept. Agric. Dept., Dominica*, 1912, p. 12.

Dominica, as a whole, continues to be remarkably free from any serious attacks of scale-insects and the parasitic fungi controlling them continue to do most excellent work. The observations made during the year have brought to light two interesting facts. First, that the white-headed fungus (*Ophionectria coccicola*) is only found on the newer estates in the interior and that it is not found on the older estates by the coast, and further that the red-headed fungus (*Sphaerostilbe coccophila*) is found to be parasitic on the West Indian red scale (*Aspidiotus sp.*).

The white-headed fungus, which in the interior is perhaps the most vigorous of all the parasites, has possibly not been introduced on these older estates and efforts will be made during the present year to do this, and to spread this fungus on the mussel scale (*Lepidosaphes sp.*).

Theobald (F. V.). **The Aphides on Mangolds and Allied Plants.**—*Jl. Board of Agric., London*, xix, no. 11, Feb. 1913, pp. 914-922, 1 pl. and 3 figs.

This paper is a continuation of one published by the author in the Jl. of the Board of Agric., Sept. 1912.

The Boat-Gall Aphis (*Aphis atriplicis*, L.).—This is a green Aphis producing boat-shaped galls on the leaves of cultivated and wild Chenopodiaceae, including *Beta*, *Chenopodium* and *Atriplex*. It affects the upper sides of the leaves and settles mainly on the mid-rib. The effect of the punctures made by the insects is to cause the leaves to curl upwards and eventually to enclose the insects entirely. During the first week in August, according to Hayhurst and Connold, the winged viviparae leave the galls in great numbers and migrate, so that in the middle of August the galls are practically empty. The ova are placed on the calyces and seed-capsules, and on the small leaves of the upper branches, and a few in the galls. It is thought that the white goosefoot (*Chenopodium album*) when introduced into America carried this Aphis with it.

The food-plants recorded for this species are:—*Chenopodium album*, *C. murale*, *C. urbicum*, *C. quinosa*, *C. hybridum*, *C. vulvaria*, *C. polyspermum*, *Atriplex portulacoides*, *A. patula*, *A. littoralis*, *A. angustifolia*, *A. latifolia*, *A. hortensis*, *A. babingtoni*, and *A. hastata*; cultivated beet, sugar beet, and mangolds.

British Localities.—Cambridge, Kent, Sussex, Guernsey.

Foreign Distribution.—Sweden, Belgium, Germany, Hungary, Italy, and the following States in America: Nebraska, Illinois, New York, Missouri, Kansas, Colorado, Michigan, and Oregon. Gillette (Journ. Eco. Ent. iii, 1910, p. 405) describes it as a very abundant species, generally distributed in Colorado upon both sides of the mountains, and up to fully 7,000 feet altitude.

The Green Mangold Aphis (*Rhopalosiphum betae*, sp. nov.) is very common on beets, mangolds and some wild Chenopodiaceae. The author originally took it to be Schrank's *Aphis chenopodii*.

Both Kaltenbach and Schouteden in recent years, however, place Schrank's species as a synonym of Linnaeus' *atriplicis*. The author considers himself obliged, after comparing the description, to do the same, and hence the Green Aphis, so abundant on beets and mangolds in 1911, must be described as a new species.

The Short-syphoned Mangold Aphis (*Aphis brevisiphona*, sp. nov.).—A few specimens of this Aphis were found by the author with *R. rumicis* and *R. betae*, and the characters are sufficiently marked in his opinion to show it to be a distinct species.

The Teasel Aphis (*Aphis ochropis*, Koch).—This Aphis was described by Koch and also by Kaltenbach as found on the teasel (*Dipsacus sylvestris*) and on *Chenopodium*. The author has taken it once only on dock, and never on Chenopodiaceae.

Remedial and Preventive Measures against Aphids.—Enquiries were made of the author in 1911 in consequence of local outbreaks as to the best methods of clearing Aphis from root-crops. Nicotine wash was out of the question as being too expensive, and trials were made with soft soap and quassia and paraffin jelly, with good effect. It was found that when the wash was discharged with considerable force, a large quantity rebounded from the roots to the underside of the leaves with excellent results. The proportions used were:—soap 8 lbs., quassia 5 lbs., water 100 gallons.

Spraying for the attack of "Collier" or "Black Fly" on broad beans in the garden is certainly advisable, if the insect has been allowed to spread downwards, and this may be done with much success in the field with knapsack sprayers.

To prevent infestation of mangolds, the primary host plants, especially wild poppies, must be destroyed. This is not always easy, particularly on wild places along the coast and on waste hillsides where poppies flourish, but it should be attempted. This Aphis winters on the spindle tree (*Euonymus*) both in Europe and America, and it is certainly advisable to destroy all such in hedgerows and woodlands. Docks (*Rumex*) must also be dealt with, as the Aphids winter on these plants also.

The attacked tops of broad beans should be nipped off as soon as any colony is seen, together with the sound tops, for the young lice produced by the winged females do not seem to be able to flourish on anything but the tender top growths.

Bingley in 1820 gave the advice, which in the author's opinion is very sound, that it would pay the farmers in any given district to compensate any particular person whose beans were attacked to have them completely destroyed.

Hunter (W. D.), Pratt (F. C.), & Mitchell (J. D.). **The Principal Cactus Insects of the United States.**—*U.S. Dept. of Agric., Bull.* 113, Dec. 1912, pp. 1-71, 7 pl., 8 figs.

Cactus plants of the genus *Opuntia*, which is indigenous to America, have been cultivated and transported to remote parts of the globe where they have been planted for the purpose of furnishing food for the Cochineal insect, and except in so far as this insect is concerned, other species feeding upon *Opuntia*

have until recently been rather of scientific than of practical significance. In the early days any insect that injured the food of the Cochineal insect was of importance, but with the decadence of the Cochineal industry this cactus became a nuisance, where the "tunas" were not utilised as food; thus a once valuable plant became a weed and the other insects which fed upon *Opuntia*, instead of being considered as pests, rose to the rank of benefactors, inasmuch as they destroyed a weed. In fact, in South Africa and Australia the encouragement of the insect enemies of prickly pear has been proposed as a feasible means of reducing the number of plants. In the United States the prickly pear has frequently prevented the starvation of large herds in times of drought, although the plants occupied great areas which would otherwise have furnished a good supply of forage. Investigations on the feeding value of prickly pear were begun some years ago by Mr. D. Griffiths of the Arizona Agricultural Experiment Station and it was found that this was exceedingly high. The great practical difficulty of using the plant for forage was the spines, but this has been eliminated by singeing them or by running them through machines which chop them into small pieces. The same investigator has also discovered that the plant responds readily to cultivation and that it is quite easy to double its productivity. Thus this cactus has once more become useful, and the question of insect injury to what is now a farm crop becomes one of serious consequence.

The authors review briefly previous work on pests of the prickly pear, and they classify the insects frequenting the plant as follows: (1) those which injure the plant, 92 species; (2) parasites of these injurious species, 28; (3) scavengers, 73; (4) flower visitors, 40; (5) other species only incidentally associated with the plant, 91; total, 324 species. They further classify the injurious species as: (1) attacking the roots or stems, 12; (2) attacking the joints, 27, of which 11 feed inside and 16 destroy the outer portion. Only a few of those found in the blooms are injurious, others being distinctly beneficial, as assisting fertilisation. There are 13 species which injure the fruit.

Of the insects affecting the roots and the stems the authors refer specially to 8 species of the Cerambycid genus *Moneilema*, which live on the plants all through the season and do much damage by gnawing the edges of the newly formed joints. This injury however is trifling in comparison with that done to the stems and roots by the larvae, which bore wide galleries in the stem and travel about the plant from one part to another in order to obtain a better supply of food. There is only one generation in the season and the adults generally appear in April, May and September. The injury can always be detected by the large numbers of joints and stems that have fallen to the ground, and much may be done to stop their ravages by raking together and burning this waste. The authors strongly recommend hand-collection of the insects, as they are large and wingless and not at all difficult to catch; otherwise, powdering the young joints with arsenate of lead is advised, as this will in addition serve to control at least one other insect pest.

Young plantations are often seriously injured by a cut-worm, *Chorizagrotes soror*, Smith. Wherever this insect is abundant it is easy to protect the plants by soaking the portions used for propagation for a few minutes in a solution of arsenate of lead, or the section to be planted may be dusted with the powdered arsenate at the time of planting. Three species of COCCIDAE or scale-insects attack the roots, but they have not been observed to do any damage of serious consequence.

Chelinidea vittigera, Uhler, is one of several insects which do serious damage by attacking the joints externally. It is a yellowish bug resembling the common squash bug, *Anasa tristis*, De Geer. The insects are gregarious and are chiefly nocturnal in their habits. The first indication of attack is light circular spots on the joints. During the winter the insects are to be found in quantities in a dormant state under prostrate joints. The species and its congeners are restricted to cactus plants, and are by far the most important enemies of cactus occurring in the United States. As a result of the attack the plant is weakened and soon falls over, and when the bugs are numerous the fallen plants have the appearance of having been battered down by heavy hail. More frequently however the joints dry up completely or become the breeding places for many species of scavenger insects found associated with *Opuntia*. When the plant is weakened the bugs migrate to others and continue their work of destruction. It has been observed that joints on which the bugs have fed and which have not shown any special damage during the season, are the first to be injured by frost in the following winter, and this injury may set back the growth of the plants as much as two years. The bug is also suspected of disseminating a fungus disease, *Perisporium sp.* The life-history of the bug is briefly as follows:—It breeds continuously throughout the summer and autumn, but no definite number of broods can be determined. The eggs are generally deposited on the spines to the number of about 40 per female. The nymph undergoes five moults, the stages lasting respectively 7, 4, 4, 12 and 14 days. When the temperature falls to 45° or thereabouts the bugs begin to hibernate, creeping under fallen joints, grass and the like, in the immediate vicinity of the plants. They do not appear to travel far from the plant on which they are produced. Two other species of *Chelinidea*, *C. tabulata*, West., and a smaller undescribed species have been found. They are by no means so common as *C. vittigera*, but might easily become serious pests. The best method of control is to collect and burn the trash on which the insects are found during the winter, after raking it into piles. The gasoline torch which is found on all plantations where the cactus is used for forage, is an economical and effective method of destroying the early stages.

The next most important cactus pest is *Mimorista flavidissimalis*, Grote, a Lepidopterous insect of the family PYRALIDAE, the larvae of which feed invariably on the upper edge of young joints under a silken web. It is more restricted in its range than *Chelinidea*. In Texas it is found from Hallettsville and San Antonio southward. West of San Antonio it is rare, and it has been taken at Tucson, Arizona. In the areas in which it is

common it is said to be by far the most injurious cactus insect. A generation is produced in about 30 days, and 4, 5 and even 6 generations in the year are possible. It confines its attention to young plants and it has been frequently observed that 50 to 75 per cent. of the new growth has been destroyed over considerable areas. Seven eggs are laid, all on the upper edge of the joint. The first indication of attack is the exudation of sap from the joints. If this be removed a small hole becomes visible, and as the larvae develop the discharge of sap from the plants becomes mixed with silk, trash and excrement. Sometimes the joint recovers, though always deformed; in most cases, however, decay sets in, the joint turns black and drops off. The important features of the attack of this insect are the large number of broods and the fact that it is confined to new growth, the result of which is that at the end of a season there are no more joints than there were the year before. A Hymenopterous parasite of this species, *Eiphosoma texana*, Cresson, has been reared. It does not appear however to be sufficiently abundant to exert much control over the pest. Arsenate of lead has been found very effective against this pest if applied as soon as the attack begins in the spring. In this way the majority of the first brood will be destroyed. If the first brood should not be reached in time, every effort should be made to apply the arsenate in ample time for the second brood.

A Halticid beetle *Disonycha varicornis*, Horn, frequently occurs in such numbers as to cause the death of plants of *Opuntia leptocaulis* and *O. arborescens*. It has never been found on the broad-leaved species of the genus. A Capsid bug, *Stylopidea picta*, Uhler, though not a true cactus insect, is occasionally found in large numbers on *Opuntia*, but unless the insect be unusually abundant the damage done is not great.

One of the Cochineal insects, *Dactylopius confusus*, Ckll., is often found in large masses on *Opuntia*. The author gives a brief history of the Cochineal industry in southern Mexico. The maximum production was for several years, about 1876, more than 7 million pounds, but since the discovery of aniline dyes it has declined very greatly. This insect is an important pest of *Opuntia*, but it is preyed upon by eight species of Coleoptera and three of Lepidoptera as follows:—Coleoptera: *Exochomus latiusculus*, Casey; *Exochomus marginipennis*, Lec.; *Cycloneda munda*, Say; *Chilocorus cacti*, L.; *Hyperaspis trifurcata*, Schaef.; *Hyperaspis cruenta*, Lec.; *Scymnus loewi*, Muls.; *S. horni*, Gorh. Lepidoptera: *Laetilia coccidivora*, Comst.; *Zophodia dilatifasciella*, Rag.; *Saluria ardiferella*, Hulst.

The best means of control when the insects are not required for commercial purposes is to remove the masses on the joints by means of a very stiff brush or to burn them with a torch. The extensive secretion of the insect greatly interferes with the application of insecticides.

The Pyralid moth, *Melitara junctolineella*, Hulst, and other species of the genus are true cactus insects. The eggs are laid in masses of as many as 30 together, and there appears to be only one brood each year. As soon as the larvae hatch in the spring they begin feeding on the surface of the joints and in a few days

make their way to the interior. All observers are agreed that never more than one or two larvae are found within a joint; this is remarkable in view of the fact that the eggs are deposited in such large numbers. The larvae have never been found travelling, and it is believed that their cannibal propensities afford at least a partial explanation, but their work also largely involves their own destruction as they become involved in the repair tissue formed by the plant. The joints swell to as much as four times their normal thickness, and the injury is often made greater by a number of scavengers, principally Dipterous. A large amount of the damage is done by the larvae passing through the stem from one joint to another, and in this way one may kill several joints. The insect cannot be said to be extremely abundant, but it is found throughout the cactus area, and the total damage done is considerable. Certain differences in habit which have been observed lead to the belief that there may be more than one species involved. The Tachinid parasite of this species, *Phorocera comstocki*, Will., is common. It has been reared from material collected throughout the cactus area. The only method as yet found useful for keeping the pest in check is the use of the torch.

The following are also described as attacking joints internally:—*Melitara dentata*, Grote, *M. fernaldialis*, Hulst, *Gerstaeckeria porosa*, Lec., *G. clathrata*, Lec., and the Tineid moth, *Marmara opuntiella*, Busck. Of species injuring the blooms there is only one which is of any consequence, *Trichochrous* (*Pristoscelis*) *texanus*, Lec., a Scarabaeid beetle. In certain places this has at times been found in such abundance that a great majority of the plants ceased to bear fruit. The Coreid bug, *Narnia pallidicornis*, Stål, is important as a pest only when the fruits are desired for food. On account of its gregarious habits and its location on the parts of the plant easily reached by a gasoline torch, its control is not difficult. Three other species of the genus are also described as feeding on the fruit, and also four species of Cecidomyiidae. The 73 species of insects described by the author as scavengers live for the most part on the joints after these have been killed by other insects or when they have been blown off. Many however breed in the living joints, obtaining entrance through the burrows of *Moneilema*, *Melitara* and other forms, increasing the diseased condition caused by the first comer. The most common of these is a Syrphid fly, *Copestylum marginatum*, Say, and two species of *Hermitia*, *H. chrysoplia*, Loew, and *H. hunteri*.

The report concludes with a list of insects directly or indirectly injurious to, or associated with, *Opuntia* and a lengthy bibliography.

Insect Pests in the Virgin Islands.—*Agric. News, Barbados*, xii, 1st Feb. 1913, pp. 42 & 43.

This is an account of the entomological observations made in the Virgin Islands by Mr. A. J. Tempany, of Antigua. At the time of his visit continued heavy rains had followed prolonged

drought and insect life was very abundant. The cotton caterpillar, *Alabama argillacea*, was found abundant in Tortola and Virgin Gorda. The attack was so severe that for the first time it was found necessary to organise the destruction of the pest by insecticides; natural enemies, which had previously exercised a fairly efficient control, having failed on this occasion. The conditions under which cotton is usually grown in the Virgin Islands are such that the areas cultivated consist largely of isolated small plots surrounded by high bush; this the author regards as favouring natural control. The "black witch" bird, *Crotophaga ani* (*see* p. 36), appears to exercise considerable control over the cotton pests and there is a large mason-bee which is also predaceous, as well as certain species of *Polistes*, known as Jack Spaniards, possibly *P. fuscatus instabilis*, which is common in the Leeward Islands, but probably not the same species as that which has proved a valuable enemy of the cotton worm in St. Vincent and Barbados (*P. annularis*). Other pests of cotton were not specially abundant, but some damage was recorded by cut-worms and also a small gray weevil differing apparently from that which was responsible for similar damage in Antigua. Limes were on the whole remarkably free from scale-insects. The common species found are the purple scale, *Lepidosaphes beckii* (*Mytilaspis citricola*), the green scale, *Coccus viridis* (*Lecanium viride*), and the white scale, *Chionaspis citri*. The scale-fungus *Cephalosporium lecanii*, was observed however to be present in great quantity, parasitic on the mango shield-scale and other Lecaniums in and around the Experiment Station. A yellow weevil attacks the leaves of lime trees and does considerable damage. This is stated to be probably a species of *Diaprepes*, quite different from the root-borer of sugar-cane in Barbados (*D. abbreviatus*) and resembling *D. spengleri*, though apparently distinct from it. The grub of *D. spengleri* is reported to attack the roots of orange and other citrus trees in Porto Rico; it also occurs in St. Vincent, where however the habits of the grub do not seem to be known. In Virgin Gorda sweet potatoes were found to be very badly damaged by the sweet potato hawk-moth, *Protoparce cingulata*; while at the Experiment Station some damage had been done to arrowroot by the arrowroot worm, *Calpodes ethlius*.

Middleton (M. S.). **Injurious Insects in Kootenay.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 17-19.

This district is stated to be remarkably free from insect pests, and none are serious. In the past year *Eriosoma* (*Schizoneura*) *lanigera* has not made its appearance in the district, though *Aphis mali* showed itself in great numbers early in the spring, but did not spread to any extent. Spraying over Green Aphis with lime and sulphur mixture is said to have had little effect in destroying the eggs on the branches. The Aphides were hatching out and spreading over branches which were yellow with lime and sulphur. Black Leaf 1-70 gave good results when thoroughly applied, but the newer mixture, Black Leaf 40, was less satisfactory.

A Leaf-miner (*Tischeria*) was fairly abundant in orchards near the timber line. This insect does so little damage that no means of control are practised. The fly known locally as the " salmon fly " or " cicada " did much damage to young trees along the Columbia River by laying its eggs in slits made in the new shoots, causing them to snap off later in the wind.

" Climbing cutworms " were exceptionally troublesome, as many as sixty being sometimes taken on one small tree. This was brought about by a catch-crop of clover having been ploughed in in the spring; in many instances every single bud was eaten. Poisoned bait—100-lb. bran, 1-lb. Paris Green, and 2-lb. sugar—was tried without result, but another mixture—50-lb. bran, 1-lb. Paris Green and 3-lb. sugar—was applied with good results, the worm seeming to prefer it to the buds. The mixture should be applied fairly dry and crumbly and should be sweetened according to the plants upon which the larvae are feeding.

The author gives a warning against the use of Paris Green on young and tender plant growth. If applied too close to the trunk it appears to have a girdling effect on the plant. In a number of places young trees were completely girdled from no other cause. Larger trees do not suffer in the same way, but it is reasonable to suppose that even on matured wood the effect of Paris Green is not beneficial.

The California tortoiseshell (*Vanessa californica*) was found in such large numbers on the Ceanothus along the Columbia, Slocan and Kettle Rivers that fruit-growers became alarmed. Fortunately the larvae did not leave their proper food-plants for cultivated trees. The author thinks that they must have been very heavily parasitised, as the second brood, which was to be expected in the latter part of the summer, was exceedingly small.

Brittain (W. H.). **Beneficial Insects.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 32-38.

The writer reviews briefly our knowledge of the parasites of injurious insects, and the results obtained in the United States and elsewhere from their importation. He remarks that many noxious weeds are subject to the attack of insects to such an extent that these insects must be considered as beneficial. He wished to collect a supply of seeds of the common Canada thistle and found it exceedingly difficult to obtain a sound seed over a large area in consequence of the flower heads being attacked by a small maggot. Among beneficial insects he cites the milkweed butterfly (*Anosia plexippus*), thistle butterfly (*Pyrameis cardui*), and the purslane hawk-moth (*Deilephila lineata*).

Cunningham (T.). **Inspection of Fruit for Pests.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 50-71.

The author, in the course of an address to the British Columbia Entomological Society, says that British Columbia has a reputation to-day of being the only Province in North America that is

free from the Codling Moth, San José Scale, Gypsy and Brown-Tail Moths, and several fruit-flies.

He quotes at length examples of quarantine orders by various States of the Union against the following insects: *Aleurodes citri*, *A. nubifera* (on citrus trees); *Phytonomus posticus* on alfalfa; *Sanninoidea pacifica* (Western Peach-tree Borer); *Anthonomus grandis* (Cotton-boll Weevil); *Chrysomphalus aurantii* (California Red Scale), *Chrysomphalus aurantii* var. *citrinus* (California Yellow Scale), *Laspeyresia* (*Carpocapsa*) *pomonella* (Codling Moth), and the scale-insects *Aspidiotus perniciosus*, *Aspidiotus rapax*, *Saissetia oleae* and *Lepidosaphes ulmi*, and *Anarsia lineatella* (Peach Worm).

A case is cited in which an isolated outbreak of the Codling Moth, though on a very small scale, was stamped out by the purchase and immediate cooking of all the apples in three orchards with steam at a pressure of over 120 lbs. on the inch, and it is stated that this method has been introduced into Australia and New Zealand for dealing with all imported fruit which is known to be infested. The author points out that the attack of Codling Moth referred to probably arose from nursery stock imported from Oregon, from certain fruit-houses known to be badly infested.

The system of purchasing and destroying fruit cannot be continued on account of the expense, but it is hoped that the spraying of suspected orchards with arsenate of lead, two or three times in the season, under Government inspection, may prove effective against any possible further outbreak.

Railway cars have been found to contain numbers of cocoons of the Codling Moth, and methods by which these cars can be properly disinfected are under consideration, though no definite plan has been arrived at, the problem being somewhat difficult of solution.

DAY (G. O.). **Notes on** *Schizura unicornis*, **Smith and Abbot.**— *Proc. Br. Columbia Entom. Soc.*, 1912, pp. 40-41.

The writer describes the caterpillar and says that they are found on apples, plums, apricots and other plants, and eat a good many leaves without leaving much trace of their ravages. They are not very plentiful or likely to become a pest. The larvae are found in September, and the moths appear in the following June.

LYNE (W. H.), Asst. Inspector of Fruit Pests. **Carbon Bisulphide Fumigation.** — *Proc. Br. Columbia Entom. Soc.*, 1912, pp. 28-31.

Many hundreds of tons of imported rice and grain are treated at the Vancouver and Victoria fumigating stations every year as follows:—The sacks containing the rice or grain are stacked two or four deep on the floor of the fumigation chamber. Soup-plates are placed at equal distances on top of the sacks, all windows and doors are sealed, and the amount of liquid carbon bisulphide

necessary to the cubic space measurement of the chamber is distributed in equal quantities in each soup-plate. The chamber is then closed and sealed for thirty-six hours.

For every ton of grain 1-lb. of carbon bisulphide is required, and it has been found that 36 hours' exposure to the vapour will kill any insect confined in grain, roots, or fruit.

When Japanese brown rice was first imported into Vancouver the question arose as to whether the carbon bisulphide fumes would affect the flavour. To test this, two separate lots of rice, one which had been treated and the other not, were cooked in separate vessels, and submitted to the Japanese importers and others to taste. They failed to distinguish between the two. Similar results were obtained with pineapples, oranges, apples and pears. If perfectly dry, the germinating power of grain, seeds and bulbs is not injured.

In the use of carbon bisulphide against orchard pests certain precautions must be taken, otherwise the trees may be killed. Some years ago the fruit-growers in California began using carbon bisulphide extensively against *Sanninoidea opalescens* (Peach-tree Root-borer). Numbers of trees were killed outright and others injured. The plan adopted was to make a trench about 6″ deep around each tree, pour in one or two ounces of the liquid and fill in the trench with soil. In twenty-four hours the borers were dead, and the soil round the tree was then removed and the space well aired before replacing it. Unfortunately great carelessness was shown in allowing the liquid to touch the bark of the trees, and this frequently happened also in consequence of the soil being too wet at the time of application. The author says that he once saw ten acres of seven-year-old prune trees on almond stocks totally destroyed by carelessness in the application of carbon bisulphide.

According to the author, 36 hours at least of exposure is required to kill the eggs of the Mediterranean Flour Moth.

The case is recorded of a car-load of beef scraps from Chicago, which was alive with predaceous beetles of all kinds, being satisfactorily treated with carbon bisulphide.

Wilson (T.). **Insect Pests in Vancouver.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 5-8.

The unusually wet season of 1912 has prevented the propagation of many pests throughout the Fraser Valley and the surrounding district. The attack of the caterpillars of *Malacosoma erosa* was confined to the west and south-west of the mainland, comprising part of the Municipality of Surrey and part of the Delta as far as Blaine on the American boundary. In the town of Blaine these caterpillars were a great nuisance, crawling over fences and into open doors and windows, and all along the shore of Simiamhoo Bay the orchards and all the deciduous trees were completely stripped of leaves. Further inland many of the larvae, although plentiful, seemed to dry up and did no harm, and nearly all were attacked by a parasite as yet not determined.

A bad, though isolated, attack was reported around Agassiz, which however did not extend beyond a mile east of the town. The author remarks that American authorities have confirmed his observation that this caterpillar never attacks pear trees.

Schizura concinna (Red-humped Apple-tree Caterpillar) did great damage in the drier parts of the Fraser Valley. It was quite common to see four or five caterpillars on one leaf. The author found that some were attacked by an Ichneumonid parasite, *Limnerium* (*Limneria*) sp.

Hyphantria textor (Fall Web-worm). This caterpillar appears to attack and destroy the leaves of all deciduous trees. Ornamental trees, apart from the actual damage to the leaves, are rendered unsightly by the filthy webs full of the remains of the caterpillars and their excreta.

Spilonota (*Tmetocera*) *ocellana* (Bud-moth) was very common, and injured apple, plum and cherry trees, but especially the Italian prune, the output of which was said to have been reduced by one-half.

Psylliodes punctulata (Hop Flea-beetle) was fairly plentiful at Chilliwack, but did not do so much damage as usual. This insect will eat nettles, clover, chickweed, tomatoes, beet and other farm crops.

In the Nicola country *Chionaspis pinifolia* did great damage to the bull pines (*P. ponderosa*), some of the trees being so seriously attacked as to be powdered over from top to bottom with "frass."

Anderson (E. M.). **Injurious Insects in Victoria, British Columbia.** —*Proc. Br. Columbia Entom. Soc.*, 1912, p. 9.

The writer states that though the Tent Caterpillars did a large amount of harm in the past year in the Victoria district, over 60 per cent. of a very large number examined were found to be infested with the ova of a small ichneumon fly, which it is hoped will cause a great reduction of their numbers this year. *Neophasia menapia* (Pine White Butterfly) was curiously absent in the outskirts of Victoria; in places where in previous years thousands were to be seen, hardly a single specimen could be procured. *Therina* (*Ellopia*) *somniaria*, Hulst, did not cause so much damage to oaks as in previous years.

Green (Ernest E.). **Injurious Insects in Ceylon.**—*Rept. Govt. Entom. Dept. Agric., Ceylon*, pt. iv., 1911-12, pp. 2-5.

Tea Pests.—*Xyleborus fornicatus* (Shot-hole Borer) is still the principal subject of inquiry. There has been no marked increase in its range. In the Madulkele district it was found to be spreading from a native-owned estate where the prunings had not been destroyed. The Dikoya and Maskeliya districts and the greater part of Dimbula still remain free, and may continue to escape

infection if care is taken to avoid the introduction of tea plants grown in infected localities. There is no doubt that the pest would never have established itself so widely had it not been for the constant employment of outside nursery plants instead of seed. If all plants for new clearings were grown on the place where they were required, there would be little or no danger of the introduction of the borer, for seed is never infested.

At the instance of certain districts, Shot-hole Borer has been proclaimed as a pest under the Plant Pests Ordinance of 1907.

The question of the utility of the predaceous beetle (*Clerus formicarius*) as a possible enemy of Shot-hole Borer has been finally set at rest by the receipt of a few living larvae of that insect. It was at once apparent that these larvae were several sizes too large to be of any use.

Capua coffearia (Tea Tortrix) has been reported from several districts, but trouble from this pest has been much less general than in previous years. This may be due, partly to a greater amount of rain during the early months of the year, which favours disease amongst the caterpillars, and partly to better cultivation.

There has been a marked scarcity of complaints of other caterpillar pests. No notice was received of Nettle Grub (Limacodidae). Isolated outbreaks of Red Slug (*Heterusia cingala*) and *Caradrina reclusa* have been reported from the Kalutara and Deniyaya districts respectively. Two instances of minor attacks of the Small Tussock caterpillar (*Orgyia postica*) have occurred in the Deniyaya and Balangoda districts.

Helopeltis also has attracted very little attention, a single complaint from the Galle District and another from Kadugannawa being the only instances that have been brought to notice.

Tarsonemus translucens (Yellow Tea Mite) has been reported from the Galle District. *Calotermes militaris*, a White Ant that hollows out the stems of living tea bushes, still occurs sporadically on some of the Lindula estates. Apparently the only cure for this pest, which breeds inside the stems, is to dig out and burn the affected trees.

A very remarkable case of infestation of manufactured tea by a *Dermestes* beetle has been investigated. The tea was packed in the usual way and samples were retained in the Colombo agent's office. These samples show no trace of infection. But when the consignment was opened in Europe, chest after chest was found to be alive with beetles and fouled by the dead bodies of their larvae and pupae. The lead lining of the chests was said to be intact, and there was no evidence that the beetles had been feeding upon the tea. No explanation of the presence of the insects is as yet forthcoming.

Rubber Pests.—The large root-borer of Hevea, described and figured in the "Tropical Agriculturist" of September 1910, p. 221, appears to be growing more common in the Kelani Valley district. Complaints of damage by this borer have come in from Avisawella, Padukka, Waga and Undugoda. One correspondent reports that a group of half a dozen 5-year-old trees has been killed by this pest. Six or seven of the grubs have been found

in a single tree. The borer is a large, whitish, fleshy grub, more or less cylindrical in form, but with the segments immediately behind the head much broader than the others. It is the larva of a Longicorn beetle, but of which particular species it is impossible to say at present. Meanwhile it will be advisable for rubber planters to regard all the larger Longicorn beetles with suspicion, and to destroy them when found in their rubber clearings. Specimens have been received of Scolytid beetles (allied to the Shot-hole Borer of tea) extracted from the stems of Hevea trees, and believed (by the senders) to be responsible for injury to the trees; but Mr. Green does not appear to consider them as being of any serious consequence. The principal species that have been found in Hevea trees are *Xyleborus semiopacus*, *X. discolor*, *X. interjectus*, *X. perforans*, *Platypus solidus*, *Eccoptopterus sexspinosus* and *Cryphalus plumierae*.

Among the minor pests which have been the subject of inquiry and investigation are:—*Arbela quadrinotata*, the caterpillar of which tunnels into the angles of the branches of cacao; a Membracid (*Leptocentrus substitutus*), puncturing young shoots of indigo plants; the Pumpkin Fly (*Dacus cucurbitae*), destructive to fruits of vegetable marrow; the Paddle-legged Bug (*Leptoglossus membranaceus*), puncturing various fruits and vegetables; the Painted Bug (*Bagrada picta*) puncturing leaves of cabbages, knol-khol, etc.; the Red Scale (*Aspidiotus aurantii*), on stems of mulberry plants; caterpillars of a Pyralid moth (*Nymphula depunctalis*), defoliating rice plants; a Shot-hole Borer (*Xyleborus coffeae*), tunnelling in young branches of *Coffea robusta*.

White Ants.—It has been stated, in several quarters, that the explosion of carbon bisulphide in a termites' nest will kill all the inmates. An experimental test of this method at Peradeniya has proved an absolute failure. Several nests were treated with the liquid (poured into the main shaft of each nest) and the charge exploded. The holes were then blocked up for twenty-four hours, when the nests were opened and examined. The effect upon the insects was apparently *nil*. "Solignum" has proved an excellent preservative of woodwork, against the ravages of white ants. From tests initiated in 1909 it was found that where the wood is exposed to the weather, the effect of the preservative wears off in about three years' time. Samples of Lawton's "Ant-proof Mill-board and Notarial Paper" have been tried experimentally at the laboratory and appear to have withstood the tests satisfactorily. They have not been touched by termites though placed under a plank of wood that was swarming with *Coptotermes ceylonicus* (a species that shows a partiality for the mill-board coverings of books).

A Pest of Stores.—Samples of "weevily" ration biscuits have been received from Diyatalawa Camp. They were found to be attacked by two distinct beetles and the larvae of an undetermined moth. The beetles concerned were *Lasioderma testacea* and a species of *Trogosia*.

Lac.—Another attempt to establish the Indian lac insect (*Tachardia lacca*) in Ceylon, has been made, but without success.

VENABLES (E. P.). **Injurious Insects in Okanagan District.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 11-16.

Hyphantria textor (Fall Web-worm) was more abundant than for many years past; the choke cherry tree, its natural food-plant, is occasionally entirely defoliated. Burning out the webs with a torch is the most simple method of extermination.

Aphis mali (Apple Aphis) was fairly numerous in July, and much spraying was required to keep them down in the new orchards. The "black leaf 40" mixture was used with great success in fighting this insect, as well as other species of plant pests. The COCCINELLIDAE were not so abundant as in other years when aphids were common.

Otiorhynchus ovatus is becoming more numerous every season, and the damage to strawberry plantations is considerable.

SIMULIIDAE (Black Flies) were very troublesome to stock during late summer and early autumn. The species have not yet been determined.

Gastrophilus equi (Horse Bot-fly) is another stock pest which was unusually abundant in 1912.

The following are among the insects also reported as doing variable amounts of damage, occasionally serious:—

Tmetocera ocellana (Bud-worm).—Both broods very common at Victoria, rare in the Okanagan.

Eriosoma (Schizoneura) lanigera (Woolly Apple Aphis).—Fairly common everywhere throughout this season. Winged forms quite common in the fall; no root forms seen. Not a serious pest in well-cared-for orchards.

CAPSIDAE (Plant Bugs).—Injuries resembling those done by various Capsids were very common to the young apples of some varieties. In some cases this caused an extensive drop of the young apples and in others the fruit remained on the tree, but became badly distorted. Injuries of this kind caused quite a little loss in some places and the subject demands further study.

Tetranychus bimaculatus (Red Spider).—Quite common everywhere, doing appreciable damage to plums in some cases.

Corymbites inflatus and *C. hieroglyphicus* (Click-beetles).—Very abundant in nearly all parts of the valley, feeding upon the buds and young leaves of young apple trees. Damage done in many instances was considerable and some control measures should be worked out.

Cercopeus artemiseae and *Mimetus setulosus* (Bud-weevils).—Not widespread, but doing considerable damage to young apple trees in isolated cases by boring into buds and tender foliage. Deserve further attention.

Eriophyes pyri (Pear-leaf Blister Mite).—Quite common, injuring pears only; liable to increase in destructiveness.

Empoasca mali (Apple Leaf-hopper).—Very common everywhere; does some damage and is rather difficult to control.

Malacosoma sp. (Apple Tent Caterpillar).—Quite common during the month of May. Subject to periodic epidemics, but is easy to control.

Enarmonia prunivora (Lesser Apple-worm).—Present in most districts, but not in large numbers.

Hyphantria cunea (Fall Web-worm). Abundant on apples and wild shrubs; easy to control.

Glyptoscelis pubescens (Grey Bug).—Said to be doing considerable damage by feeding upon the unfolding leaves of young apple trees. The author did not see it actually at this work, but found it upon trees the leaves of which had been badly eaten. Should be watched.

Apple Saw-fly.—A green larva, about 3 cm. long, making burrows in the mature or nearly mature apples on the tree. Did considerable damage in a few cases. It burrows into the apple apparently for the purpose of hibernation, as the larva remains quiescent after making its burrow. Its regular food is probably some wild plant and injury to apple only incidental. More information required.

Sanninoidea sp. (Peach Tree Borer).—Quite common where peaches are grown; a number of trees were killed.

Anarsia lineatella (Peach Twig-borer).—Common, the chief damage being done to the fruit.

Hemerocampa leucostigma (White-marked Tussock Moth).—Not common this season, but often a serious pest of shade trees.

Pseudococcus, probably *sp. n.* (Mealy bug).—Injuring spruce; easily destroyed by lime-sulphur.

Chermes similis (Spruce Gall-louse).—A common and serious enemy of the spruce.

Bezzi (M.). **Intorno ad alcune *Ceratitis* raccolte nell' Africa occidentale dal Prof. F. Silvestri.** [On certain *Ceratitis* collected in West Africa by Prof. F. Silvestri.]—*Boll. R. Scuola sup. Agric. Portici*, vii, pp. 1-16.

The author describes the following species obtained by Professor Silvestri:—*Ceratitis punctata*, Wied., from Konakry in French Guinea, feeding on a species of *Conopharyngia; C. inscripta*, Graham, taken in southern Ashanti; *C. stictica*, Bezzi, from the Congo and Ashanti; *C. giffardi*, sp. n., taken at Dakar, in Senegal, feeding on a species of *Chrysobalanus; C. silvestrii*, sp. n., also taken at Dakar and feeding on the same fruit as *C. giffardi; C. bremii*, from Senegal; *C. morstatti*, sp. n., taken by Dr. Morstatt at Victoria, Kamerun, feeding on kola nuts and destroying the pulp; known to the German planters in Kamerun and Togo as "Springmaden der Kola-Nuss."

Theobald (F. V.). **An unrecorded Apple Sawfly in Britain (*Lygaeonematus moestus*, Zaddach.)**—*The Entomologist*, March 1913, pp. 108-109.

Larvae of this insect were sent to the author from two places in Hampshire and from Berkshire; he has also found it at Wye in Kent. At the localities in Hampshire the flies were doing much damage and stripping the trees.

Dudgeon (G. C.). *Gelechia gossypiella* (Pink Boll Worm).—*Agricultural Journal of Egypt*, ii, pt. 2, 1913, pp. 1-4, 1 pl.

The occurrence of the Pink Boll Worm in Egypt appears to have been overlooked by writers previous to 1911, although specimens have been frequently found throughout the country for many years. The insects infest bolls in the green state in the same localities as those in which *Earias insulana* occurs, and it is possible that damage attributed to the latter is really the work of the former.

In the end of August 1912, a quantity of bolls sent from Kôm Eshon all proved to have been attacked by the Pink Boll Worm, and a very large percentage of bolls examined at Edfina and at Fûa contained larvae of this species.

In West and East Africa the Pink Boll Worm occurs most frequently alone. For the most part the damage done in Egypt has been slight, but it is important to note that in 1912 this insect had done appreciable harm to cotton in the north of the Gharbîa and Beheira provinces.

The larvae enter the bolls when they are more than half ripe, the eggs being probably, though not certainly, laid on the boll itself; the point of entry is, however, exceedingly difficult to find. They feed upon the seeds, usually destroying those in one cell of the boll only, whereas *Earias* frequently destroys all the cells, besides attacking many flower-buds, and other bolls upon the plant.

The author has found *Dysdercus superstitiosus* in Sierra Leone and S. Nigeria, sucking the juices of the Pink Boll Worm; this Cotton Stainer is not found in Egypt. The only other insect which has been noted as attacking the Pink Boll Worm is a Chalcidid, *Chelonus blackburni*, occurring in Hawaii. *Gelechia* has been found recently feeding on Tîl (*Hibiscus sp.*), and the author has also bred it from pomegranate.

Treherne (R. C.). **Life-history of *Otiorhynchus ovatus*, the Strawberry Root Weevil, under Lower Fraser conditions.**—*Proc. Br. Columbia Entom. Soc.*, 1912, pp. 41-50.

This insect is reported as causing great loss to strawberry-growers, not only in the Lower Fraser Valley, but in those sections along the Pacific Coast where strawberries are grown on a large scale. The common names of the pest are:—the "Pitchy-legged Otiorhynchus," the "Strawberry Crown Girdler," and the "Sleepy Weevil." The writer prefers to call it the "Strawberry Root Weevil" because he has not found it attacking the crown in any case, and he believes that it feeds only on the roots of the plant; its larvae having been found on them 6″ to 8″ below the surface. It is far more numerous than *O. sulcatus*, and at present is a serious pest. The incubation period is about 21 days; the larval stage at least 7 months; the pupal stage occupies 21-24 days, and apparently some 12 days more are required for the insect to assume its full adult characters. Adults have been

found to live in captivity from 42 to 67 days, but the author is of opinion that the latter figure should be regarded as a minimum. The insect only feeds at night and during the day-time hides in crevices of the soil under leaves and rubbish. The author is also of opinion that the eggs are laid at night. The larva is more or less omnivorous and has been taken on clover and timothy grass roots, on wild strawberry 500 feet above the sea, and on the roots of the peach; on rhubarb, *Rumex acetosella*, *Potentilla glandulosa*, *Balsamorhiza sagittata*, *Poa cerotine*, *Poa pratensis*, and on white clover; it has also been found in potato fields, though there is no direct proof of its eating potato roots. The local farmers are of opinion that red or crimson clover is not attacked to any appreciable extent. Adults have been caught feeding on the fruits of strawberry, raspberry, vine, peach and apple. The leaves of strawberries are also eaten, but not to any great extent. Treherne is strongly of opinion that no special variety of strawberry is either safe from the attack of the insect or specially liable to such attack. Some resist better than others, and he recommends certain varieties of vigorous growth with deep roots. The larvae attack the roots by making longitudinal slits in portions of the epidermis, subsequently girdling the roots either directly or in a spiral manner. The pupal stage is passed at from 4″ to 6″ or even 8″ below the surface. The most serious damage is done in early spring when the larvae are nearly full-grown and are capable of attacking the main roots of the plant, which are sometimes nipped off 2″ or so from the crown. The author summarises the observations as to attack as follows:—"if no injury to the plantation has become apparent by the end of June of one year, no further injury will become apparent that year" or in other words, "the plants attacked in the spring of one year, having reached their highest degree of injury by the end of June, for the remainder of the year tend to improve and re-establish themselves in the soil." This point should be made use of in the matter of applying commercial fertilisers.

The female appears to lay about 50 eggs over a period of 4 or 5 days. This period may be extended to as much as 15 days. The eggs are laid from the end of June to the end of August, varying somewhat according to season. There appear to be two periods of the year in which the insect migrates, though it has a strong tendency to remain localised, provided there be sufficient food and protection. The first migration takes place about the middle of July, during the egg-laying period, and the second during the autumn, possibly for the purpose of seeking winter quarters. What proportion of the insects actually migrate, has still to be determined, for hibernating adults can be found all the year round on the surface of the crown in a strawberry plantation. Strawberries grown on the matted row system are not as a rule seriously affected the first year after planting, unless the soil was previously infested by the insect. The injury is noticeable in the third summer, often reducing the crop 50 crates to the acre from what might, with reason, be expected. Where the plantation is kept down for more than 3 years the crop may be totally destroyed.

Rotation on a large scale, that is to say, removal of the strawberry ground to a considerable distance from that occupied by the previous crop, is recommended. Unfortunately this is not so effective as it might be because the insects feed on the roots of such vegetation as they find on the way to the new plantation. The pest is considered to be so serious that unless radical measures are taken to prevent its introduction into strawberry plantations the industry will prove altogether unprofitable. The following remedial measures are suggested:—(1) the growth of strong varieties; (2) the running of chickens over the grounds; (3) trapping the adult weevils under boards (only useful to small growers); (4) the use of some sticky material as traps; (5) spraying with arsenate of lead (only useful after the first crop is harvested and when the weevils are very numerous); (6) chemical remedies, potassium cyanide and carbon bisulphide; but the author is doubtful whether any remedy of this kind can be used to kill the eggs, larvae or adult which will not at the same time destroy the plant; (7) burning the plants immediately after the first crop has been gathered by covering them with dry straw and setting fire to it; (8) ploughing at the end of July or at the beginning of August, with frequent cultivation previous to or during winter; (9) autumn planting; (10) plant renewal during the middle of the second summer; (11) one-year crops instead of two-year crops, though this is not satisfactory; (12) rotation of crops is strongly advocated in this order, derived from local experience:—strawberries, potatoes and rhubarb, and not more than one acre in ten to be laid down to strawberries in an infected locality.

Serbinow (I. L.). **Chernaia cherva.** ["Black brood" in bees.] —*Vestnik Russkavo obstschestva pchelovodstva*, no. 11, Nov. 1912, pp. 426-429.

The author deals with the disease known as "black brood" and describes his own experiments on the nature and origin of this dangerous pest of the larvae of bees.

Upon the first appearance of this disease in the years 1898-1900 in New York it was taken to be the well-known "foul brood," but later on it was recognised as a special disorder, not all the symptoms of the latter disease having been found in the former. Whereas the larvae attacked by "foul brood" show considerable ropiness and have a strong smell of hot joiner's glue; in the case of "black brood," the ropiness is less distinct and the smell rather resembles that of sour apples. "Black brood" attacks the sealed as well as the unsealed larvae, the dead ones turning first yellow, then brown and finally black. The opinion that this is a distinct disease was shared by Root, who named it the "New York disease," and by many prominent beemasters. According to their opinion "foul brood" is caused by a bacterium known as *Bacillus alvei*, whereas the cause of "black brood" is some other unknown bacillus. Investigations carried on in late years by other investigators, especially by White and Moore, led to a new controversy as to the nature of this disease, and White came to

the conclusion that *Bacillus alvei* usually provokes "black brood" which is the true form of "foul brood," the disease commonly known under this name being only a special "slimy form" of the former and resulting from the action of a special bacillus.

During last summer "black brood" appeared in some of the author's hives and he decided thoroughly to investigate its nature and origin. He gives the following description of the cause of the disease. "Black brood" attacked only the unsealed larvae in all their different stages, starting with the eggs. The infected larvae lost their pearly appearance, occasionally took on an irregular form, their bodies being streaked first with grey and afterwards with small black striae. At this stage the larvae were already dead. Later on they turned black and sunk to the bottom of the cell in the form of a black slightly ropy mass, having a smell resembling that of sour apples, which, however was never very strong. The workers were all the time busy trying to separate the eggs from these larvae and clean them, but as the disease runs its course in 2-4 days and spreads quickly through the hive, they cannot succeed in throwing out all the bodies of the dead brood.

In order to discover the origin of the disease the author prepared cultures of the bacteria, using ordinary alkaline meat-pepton agar, and also on agar from an extract of the brood by Maassene's method. The results were in both cases similar, and in addition to the bacteria usually found in dead larvae, *B. mesentericus*, *Sarcina lutea* and *S. aurantiaca*, he found large colonies of *B. alvei*, together with the fungus, *Aspergillus sp.*, occurring always amongst them. Having obtained a pure culture of these bacteria he cultivated them on alkali meat-pepton bouillon and afterwards infected the bees in the observation hives by putting in them frames with young bees, not yet able to fly, and sprinkling over them the bouillon cultivation of the two last-named bacteria. On some frames the cultivation of the *B. alvei* only was used, on others a combination of the latter with the *Aspergillus*, and lastly cultivations of *Aspergillus* only. The results were similar in all three cases and the brood in every one of these developed symptoms of the "black disease." The external appearances were very unlike the typical "foul brood" of the unsealed larvae. The larvae died with all the symptoms described above. In no single case was either the typical ropiness or the smell of hot glue observable. The dead larvae were only very slightly ropy and had a slightly sour smell. The sealed larvae were always unaffected, though there were but few of these, as they almost always died before they were sealed up.

The author examined also the pollen, which for reasons which were not very clear, was brought by the bees in considerable quantity. He found that all the pollen in the neighbouring cells contained *B. alvei* and that the fresh pollen contained both the above-named bacteria.

The author arrives at the conclusion that the external symptoms of the disease known as "black brood" do not depend upon *B. alvei* and the *Aspergillus*, nor does it appear to be of conse-

quence whether the brood is infected by one or both of them, but only upon the external conditions of the larvae, the kind and quality of their food, etc. With regard to the question of the infection of the larvae by this disease the author maintains his previously expressed opinion that the *B. alvei* is taken up from dirty water and he is satisfied that the pollen may also serve as a source of infection. He is inclined to the conclusion that the difference in the external symptoms between the " black brood " and " foul brood " is produced by the bees, in the case of the first disease, feeding on infected pollen, whereas in the case of the latter the infection is derived from water. He has further no doubt that in his own hives the queens helped to spread the disease, as by laying eggs in dirty cells, they carried the bacteria on their bodies to other cells; in the same way they transported the disease from the cells containing infected pollen. He described one of the queens as always laying her eggs in the pollen, and while taking them over to the empty cells the bees carried the bacteria with the eggs. As to the method of dealing with this disease the author disagrees with the recommendations of Root and McEvoy. According to him, the only way to get rid of the " black disease " which is undoubtedly " foul unsealed brood " is to drive the bees over to a new, clean and dry hive, and to change the queen, disinfecting at the same time the hives, the instruments and the hands of the worker. The same journal contains a report of a meeting of the Russian Beekeepers' Society held on 21st October last, at which Madame S. E. Djatchenko read a report on beekeeping in the Government of Mohilov in which it was stated that " foul brood " was spreading in this district, and in the discussion which followed the opinion was strongly expressed that a conference of instructors and experts of the representatives of beekeeping societies should be called to organise measures for dealing with the disease.

NOTICES.

The Review of Applied Entomology is intended to contain, month by month, abstracts of the latest information published concerning insects injurious to man or animals, as the carriers of disease; and to forests, fruit trees, crops or stored merchandise.

The Editor will be glad to receive prompt information of the appearance of new pests, or of known pests in districts which have hitherto been free from them, and will welcome any suggestion, the adoption of which would increase the usefulness of the Review.

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